Joint Reliability Plan Track Two Unified Long Term Reliability Planning Assessment Tool Concept Paper

CPUC Staff
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I. Introduction

This paper outlines a proposal for developing a unified long term reliability planning assessment tool as proposed under track two of the CPUC's Joint Reliability Plan (JRP) proceeding.[1] The objective is to provide a framework for evaluating the availability of generation resources to reliably meet load looking forward from one to ten years. Staff is proposing (1) establishing a mechanism for transparently developing an electricity needs and supply database looking forward by year out ten years, and (2) analyzing the likelihood of generator retirements by year within the same timeframe. Staff proposes creating a modeling framework that can be used to assess the financial stability of generators within the fleet, based on the needs and supply database, and use this framework to establish the likelihood of generator retirement for each of the next ten years.

The development of a comprehensive forward needs and supply database is critical for evaluating system reliability on a regular basis, and will provide key planning metrics to energy market participants. Creating this needs and supply database, and developing a mechanism for transparently collecting, maintaining and sharing this information, is a key component of the JRP proceeding. This database will include system, local, and flexible quantities for (a) load forecast, (b) available supply (generation, Demand Response and storage),[2] and (c) contracted resources. This effort will complement the existing Resource Adequacy (RA) and Long Term Procurement Plan (LTPP) proceedings, and can inform the development of California's evolving reliability planning framework.

Increasing production from renewable resources to meet evolving procurement policy may increase financial pressures on some existing resources within the next decade, and could lead to unit retirements. One of the primary objectives of the JRP proceeding is to establish a mechanism for understanding whether potential retirements are inefficient. Specifically, will resources retire, and if so, are these retirements consistent with: maintaining grid reliability, the state's loading order, and other

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[1] Joint Reliability Plan Order Instituting Rulemaking, February 2, 2014, (R.)14-02-001
[2] Energy efficiency is accounted for under the load forecast

energy policies? Or are these potential retirements "inefficient" in that they may lead to current or future system, local or flexible reliability issues?[3]

The ultimate goal of the modeling approach proposed here is to develop a factor test[4] to establish whether a forecast retirement is inefficient. The proposed Economic Risk of Retirement Model (ERORM) will leverage modeling capabilities currently being developed at the CPUC to examine this question. The approach will employ a stochastic production simulation model to calculate revenue and flexible O&M costs for each generator in the fleet, drawing upon the forward needs and supply database. Fixed O&M costs will also be applied in establishing the financial viability of each generator in the fleet. The financial viability of each generator will then be evaluated based on the existence of contractual obligations, as captured in the contracted resources database. Resources that have been identified as potentially at risk of retiring will be evaluated based on their operational attributes and compared to CAISO Local Capacity Technical Study results, which indicate generators critical for system reliability.

II. Policy Background

The JRP proceeding was initiated to address a shortcoming in the existing CPUC procurement framework, currently managed under the Resource Adequacy (RA) and the Long Term Procurement Plan (LTPP) proceedings. Staff's proposed approach complements system reliability planning through the RA process, which currently looks at one year forward contractual requirements; and the LTPP process, which looks at system-wide physical resource needs ten years forward, but does not explicitly examine resource contracting.

The development of the needs and supply database was scoped into the JRP proceeding as a way of addressing an identified deficiency in the existing planning framework. While elements of this database currently exist and are used within various proceedings, the JRP proceeding proposes a mechanism for coalescing this information.

Several factors are fundamentally shifting the nature of the electric grid in California, and challenging the ability of the existing forward planning framework to manage our evolving fleet:

- Serving 33% of load from renewable generation by 2020,[5] with additional aggressive targets being proposed by the Governor[6] for both wholesale and distribution level resources
- A ban on the use of once-through cooling (OTC) in coastal power plants,[7] and the subsequent retirement of over 7,000 MW of OTC generators within the next ten years

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[3] [CPUC Joint Reliability Plan Track One Staff Report, October 2014](#) (Staff Report), p 15
[4] *Loc. Cit.*
[5] http://www.cpuc.ca.gov/PUC/energy/Renewables/hot/33RPSProcurementRules.htm
[6] http://gov.ca.gov/news.php?id=18828
[7] http://www.swrcb.ca.gov/water_issues/programs/ocean/cwa316/

At present, California's installed capacity exceeds expected load by 40%. While this surplus capacity should ensure reliability in the near term, it may also place financial pressure on resources already at risk of retirement, and could lead to a rapid reversal of this current long position. For example, in the near term, as renewable resource penetration continues to increase at both the system and distribution levels, there will be a need for an increasingly flexible resource stack to meet the challenges of this more uncertain and variable net load shape.[8] In addition, decreasing marginal energy prices will place downward financial pressure on existing conventional resources, potentially leading to their retirement.

At the same time, planned OTC retirements will thin out the existing conventional fleet, increasing the importance of those remaining conventional resources that have sufficiently flexible capabilities. The remaining fleet must be able to meet the demands placed on the system by a net load shape that is evolving as the proportion of renewable resources increases. The California electric grid is therefore in a state of evolution: In the short term, it has an excess of conventional resources and a minimal but rapidly growing renewable fleet. In the long term, greater changes will come in the form of increasing proportions of renewable resources and the planned retirement of OTC units. In between the current and future positions appears to lie retirements of additional non-OTC conventional units, as well as the uncertain timing of additional renewable and non-renewable resources.

The key issue this work will attempt to address is whether the CPUC can provide information to the market as well as regulators to increase the likelihood that valuable resources will continue to contribute to grid reliability. Staff proposes to use the unified long term planning assessment tool, as described in this concept paper, as a mechanism for understanding the likelihood of inefficient retirements. As defined in the JRP Tack One staff report, "…[w]hether a resource is determined to be at risk of inefficiently retiring is dependent upon a factor test, which encompasses both the valuable attributes of the resource and its financial situation."[9]

III. Proposed Process

Staff proposes addressing the development of a unified long term planning assessment tool in two steps. The first step is to develop a framework for capturing information about system needs and generation supply positions looking forward by year out ten years. The second step is to develop a stochastic modeling framework for forecasting generation at risk of inefficient retirement based on the fleet needs and supply database developed in the first step.

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[8] Net load equals system load minus the sum of solar and wind generation.
[9] Staff Report, p2

A. Forward Needs and Supply Database

Reliability planning requires an understanding of future needs as well as the system's ability to meet those needs. The RA program sets contractual capacity obligations for the CPUC jurisdictional Load Serving Entities (CPUC-LSEs)[10] on an annual basis, and LTPP looks at physical resource needs and availability out ten years. However, the CPUC does not currently maintain a needs and supply database for the interim years (i.e., between the RA and LTPP processes) that looks at both contractual and physical resources. Staff proposes establishing a mechanism for transparently developing a forward needs and supply database looking forward by year for each of the next ten years. This database will include system, local and flexible quantities for (a) load forecast, (b) available supply (generation, Demand Response and storage), and (c) contracted resources.

i. Load Forecast Database

Staff proposes developing the load forecast database from the CEC IEPR forecast,[11] which is the same load forecast that informs the LTPP process. The IEPR forecasts accounts for energy efficiency and an expected level of customer-side renewable generation (rooftop solar). In the analysis conducted for the JRP Track 1 Staff Report,[12] Staff developed an adjustment factor to correct for the percentage of CAISO-system load captured within the CEC load forecast that is not CPUC jurisdictional. This adjustment is required because the CAISO-system includes some municipal utilities that are not CPUC jurisdictional. Additional complications to calculating this adjustment factor arise when accounting for load departing from CPUC jurisdictional LSEs, which can change from year to year.

ii. Available Supply Database

The proposed available supply database will represent an accounting of all supply resources in the fleet on a year-by-year basis out ten years, including physical generation, DR and storage assets. The available supply database will be based on the LTPP forecast, as reflected by the assumptions and scenarios adopted for modeling, and summarized in the load and resources table.[13]

The available supply database will reflect all existing generation, retirements and additions on a year-by-year basis, including any supply available through DR and storage programs. Any planned resources with an existing commercial online date (COD) will be included within the available supply database. Any uncertainties reflected in contractual COD and / or retirement dates will also be captured in the available supply database by accounting for a distribution of available supply amounts by year.

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[10] The 17 CPUC-LSEs are: Pacific Gas & Electric, San Diego Gas & Electric, Southern California Edison, 3 Phases Renewables, Calpine, PowerAmerica-CA LLC, Commerce Energy Inc, Commercial Energy of California, Constellation New Energy Inc, Direct Energy, LLC, EDF Industrial Power Services (CA) LLC, GEXA Energy California, Glacial Energy of California, Liberty Power Holdings, Marin Energy Authority, Noble Americas Energy Solutions, Pilot Power Group Inc, Shell Energy North America, Tiger Natural Gas.
[11] http://www.energy.ca.gov/2013_energypolicy/documents/
[12] Staff Report, p 17
[13] http://www.cpuc.ca.gov/PUC/energy/Procurement/LTPP/

The difference between LTPP authorizations and CPUC-approved additions will reflect an expected future deficit in the available supply database to meet a particular need identified in the LTPP process. This deficit will represent authorized procurement from the LTPP that does not yet have a CPUC-approved contract and thus no firm COD. Resources reflecting the sum total of this deficit will need to be accounted for in the available supply database, consistent with LTPP procurement targets. This deficit is especially problematic when the LTPP authorization is presented as a range.

Obviously there is considerable uncertainty around how to forecast additions, related to both the physical location and the timing at which these resources show up in the system. Even after procurement authorizations yield specifically approved contracted resources, the timing of the addition still remains uncertain due to permit, financing and construction delays. Staff will be requesting guidance from parties on how to account for this deficit within the proposed supply database.

iii. Contracted Resources Database

The JRP Track One Staff report included summary information from a first draft of the contracted resources database. This database was created through a data request to all CPUC-jurisdictional Load Serving Entities (CPUC-LSEs), and contained system, local and flexible contracted resources by LSE, although local resource contracting was not shared in the report due to confidentiality issues.

Staff has updated the data request template that will be used to inform the contracted resources database and is requesting feedback on whether the proposed format is sufficient to capture the relevant information.[14] Staff proposes performing this data request on a regular basis, and is requesting feedback from parties at the public workshop related to the timing of this request.

iv. Database Reporting and Confidentiality Issues

Staff will analyze and publish results from development of the needs and supply database by aggregating results in a manner that does not compromise market sensitive information. Staff will request feedback from parties on issues related to data confidentiality and will propose a path forward.

B. Economic Risk of Retirement Model

The proposed Economic Risk of Retirement Model (ERORM) is a framework for evaluating the likelihood of inefficient generator retirement. The core of ERORM is a stochastic production simulation model that can be used to evaluate unit production costs and revenues on a monthly or annual basis. Staff's analysis and development of the needs and supply database will inform ERORM. Production costs calculated within the stochastic simulation model reflect variable O&M costs, fuel costs and unit startup costs, but do not capture fixed costs. Fixed costs are modeled outside of the stochastic simulation platform, as described below.

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[14] The template for capturing contracted resources is provided as a separate MS Excel attachment.

i. SERVM

The stochastic component of ERORM will leverage the commercially available stochastic production simulation modeling platform SERVM (Strategic Energy & Risk Valuation Model),[15] which is currently being used by the Energy Division's RA team for their Effective Load Carrying Capacity (ELCC) modeling.

SERVM calculates numerous cost and reliability metrics for a given study year as a function of weather conditions, overall economic growth, and unit performance. Variability and forecasting uncertainties for these parameters can also be incorporated. As with all probabilistic models, SERVM attempts to simulate the study year many thousands of times over, with each simulation reflecting a slightly different set of weather, economic, and unit performance conditions. Iteration conditions are selected probabilistically, and the results are weighted based on their likelihood of occurrence, in order to create an "expected value" calculation of production costs and reliability indices.

In SERVM, each study year is modeled by simulating multiple yearly synthetic load and weather conditions. In order to preserve the correlations between load and weather conditions across the geographical regions examined, load shapes are simulated based on historical weather conditions, and scaled by the peak load conditions expected for each study year. The relationship between load and weather is determined for each geographic region by examining a subset of the most recent available data, ensuring an accurate correlation between load usage and weather. Wind and solar generation profiles are also simulated based on the same historical weather conditions, as well as on the availability and location of these resources in the study year. For each of approximately thirty possible historical weather years, multiple points of load forecast error can be simulated around the expected peak load condition, creating roughly 180 to 240 scenarios for each study year. Each of these scenarios can also be run with unit outage draws as well as solar and wind forecast errors, creating thousands of iterations for each simulated study year. The results provide a comprehensive distribution of operational and reliability costs, expected unserved energy, loss of load expectation, and other reliability metrics. Expected values and confidence intervals can then be calculated based on these distributions. To summarize, the model currently incorporates:

- 33 years of historical weather.
- 33 years of synthetic load shapes – developed from a subset of the weather and historical load data – that can be scaled to reflect future load consistent with CEC forecasts.
- CAISO Master File data for detailed behavior of all generators in the CAISO footprint, including variable O&M and startup costs. A number of the data fields in the Master File are confidential, and are accessible to ED staff via an annual subpoena. Definitions for fields in the Master File are public and can be seen on the CAISO website.[16]

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[15] http://www.astrape.com/servm/
[16] CAISO Master File field definitions can be downloaded from http://www.caiso.com/Documents/GRDTandIRDTDefinitions.xls

- Detailed generator information for all other major generation sources in WECC based on the publicly available Common Case dataset available on the WECC website.[17]
- Transmission constraints for 17 interconnected regions within WECC.
- Forward gas price curves and fuel handling costs under a variety of planning assumptions, consistent with CEC forecasts. [18]
- Ability to capture forecast errors for solar and wind generation based on historical data.
- Ability to simulate on sub hourly time scales in order to capture operational flexibility needs. [19]

In order to balance the need to model the wide range of weather conditions across WECC and keep modeling times feasible, a set of representative weather stations are selected and grouped to create regions that are modeled as homogeneous areas. The regions currently being modeled by SERVM within California do not correspond to Local Capacity Areas (LCAs), and are not granular enough for transmission planning. Thus, this study is not currently intended to be a probabilistic version of the Local Capacity Technical Study. Staff is examining the feasibility of increasing the granularity of the modeled regions within SERVM to approximate LCAs.

Staff proposes using SERVM to probabilistically evaluate unit variable O&M production costs and revenues on an annual or monthly basis for all CAISO controlled generators. ERORM will then have three post processing steps in order to complete the risk of inefficient retirement calculation:

1. **Apply Fixed O&M Costs**: Integrate fixed O&M costs, including major upgrade costs, based on generator type and COD. This may be informed by the CEC Cost of Generation model.[20]
2. **Determine Whether Generator is at Risk of Retirement**: A generator is at risk of retirement if its total operational costs (fixed plus variable O&M costs) exceed revenue for a given month or year, *and* the generator lacks a long term contract. Information about long term contracting will be taken from the contracted resources database. It is assumed that any generator with a long term contract is not at immediate risk of retirement even if operational costs exceed revenue. Staff may conduct further analysis using contract price data.
3. **Determine if Retirement is Inefficient**: If a generator is determined to be at risk of retirement from step two above, then determine whether this retirement is inefficient. Determination of inefficient retirement may be informed by (a) CAISO Local Capacity Technical Studies, which identify generators deemed critical for local reliability;[21] and (b) other generator operational

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[17] WECC TEPPC 2022 Common Case datasets are available for download here: https://www.wecc.biz/TransmissionExpansionPlanning/Pages/Datasets.aspx
[18] Fuel price data is drawn from the public NAMGas database maintained by the CEC
[19] ED staff analyzed forecast and actual data from the CAISO to create realistic distributions of forecast error at day ahead and hour ahead time intervals
[20] http://www.energy.ca.gov/2010publications/CEC-200-2010-002/
[21] The one and five year Local Capacity Technical Studies can be found here: http://www.caiso.com/informed/Pages/StakeholderProcesses/LocalCapacityRequirementsProcess.aspx. The ten year report can be found here: http://www.caiso.com/Documents/AppendixEDraft2014-2015TransmissionPlan.pdf

characteristics, such as ramping speed, P_{min} or startup times that indicate the resource's value to the grid as a flexible resource. Staff is looking for feedback from parties on how to establish the mechanism for determination of inefficient retirement.

ii. Integration with Forward Needs / Supply Database

The forward needs and supply database discussed in section IIIA is used to inform the ERORM by specifying the annual system load forecast as well as the quantity and type of generation available for the model to dispatch during each yearly SERVM simulation. The contracted resources database is also used to inform risk of retirement, as described above.

iii. Sensitivity Analysis and Benchmarking

Staff will study the impact from uncertainty in the load forecast and available supply database by performing the yearly analysis under different supply and load conditions. The quantity of available supply and the modeled load will impact the overall risk of retirement. For example, for a given load forecast, increasing supply may lead to an increase in the likelihood of generators retirement: Under conditions of excess of available generation, not all generators will be critical for maintaining system reliability, with the result that some of these generators may not be able to make rent. This relationship will be studied.

Staff will perform additional benchmarking and sensitivity studies, including benchmarking ERORM against CAISO deterministic runs performed as part of LTPP.

IV. Next Steps

Staff will conduct a workshop to discuss this concept paper with parties on April 9, 2015 and will solicit informal feedback. Please send comments to david.miller@cpuc.ca.gov. Staff will establish a deadline for informal written comments at or following the workshop. Informal comments on this concept paper will help staff refine the approach, but will not become part of the record of this proceeding. Depending on the outcome of this phase of work, a future staff proposal or report may be produced and presented on the record for formal comment.

This section provides a list of questions that will be addressed at the workshop. For completeness, questions from the JRP scoping memo[22] are included here as well.

A. Scoping Memo Questions

1. What process should we adopt for developing jointly-agreed-upon input assumptions or scenarios, methods for collecting data on forward contracts or ownership of units?

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[22] JRP scoping memo

2. What methodology should we establish for completing forward planning assessments?
3. What is the appropriate forward planning horizon for the assessment?
4. What additional studies, conducted by the CPUC, CEC or CAISO may be necessary for an ongoing assessment at regularly established intervals?
5. Could establishing a procurement database enhance the efficiency of regularly conducting such assessments, the timing and time periods covered by such assessments, and confidentiality rules?
6. Should we establish a process for the State to conduct this type of planning assessment on a regular basis, and if so on what time interval?

B. Workshop Questions

1. General Comments

    a. **Overall Framework**: Does the proposed two-part approach sufficiently address issues raised in the JRP scoping memo and, in general, will it provide for an improved reliability planning framework? Will the proposed modeling approach give parties a better understanding of the potential for inefficient resource retirements within the next ten years?

2. Needs and Supply Database Questions
    a. General Database Questions
        i. **Timing**: When should Staff release the annual update of the forward needs and supply database?
        ii. **Confidentiality**: Which information in the proposed database should be made public and which should remain confidential? How should the CPUC report / aggregate information for local area resource contracting that accounts for confidentiality?
    b. Load Forecast Database
        i. **Disaggregation**: Obtaining future needs based on CEC IEPR forecast is complicated by the need to disaggregate CEC and CAISO forecasts to reflect CPUC jurisdictional LSEs. If the CEC IEPR forecast is used to assess future needs, how should this disaggregation be performed?
    c. Available Supply Database
        i. **LTPP Deficit**: The difference between LTPP authorizations and CPUC-approved additions reflects an expected future deficit in the available supply database. How can this deficit be incorporated into the available supply database in a manner that is consistent with LTPP procurement targets, while not biasing what resources could fill the deficit? With what spatial / temporal granularity?
        ii. **Data availability**: In addition to information captured within the LTPP process, is any formal data request needed to more accurately capture from CPUC jurisdictional LSEs information related to available supply or retirements occurring by year within the next ten years?

     d.   Contracted Resources Database
          i. **Template**: Does the template developed by Staff (sent as a separate attachment) sufficiently capture LSE contracting data for the purposes of this analysis? Is any data missing, or could any data be collected more efficiently?
         ii. **Timing**: When is the ideal time each year to have CPUC staff collect the contracting data from CPUC-LSEs? Should this request and reporting occur annually? For the purpose of the upcoming study, is it acceptable to parties to include an additional off-schedule data request?

3.   Economic Risk Of Retirement Modeling Questions

     a.   **Stochastic Inputs**: Are the stochastic inputs sufficient to capture expected uncertainties and variability?

     b.   **Fixed O&M Costs**: What should be the basis for calculating fixed O&M costs?

     c.   **Local Capacity Technical Studies**: CAISO Local Capacity Technical Studies examine the importance of generators for local reliability. How can results of the CAISO Local Capacity Technical studies be used to understand inefficient retirements?

     d.   **Inefficient Retirements**: "Whether a resource is determined to be at risk of inefficiently retiring is dependent upon a factor test, which encompasses both the valuable attributes of the resource and its financial situation."[23] How can a factor test be developed to inform determination of inefficient retirement? What additional factors should be considered?

     e.   **Sensitivity Studies and Benchmarking**: What sensitivity and benchmarking studies, in addition to what are described in this paper, should be performed?

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[23] Staff Report, p2